NEWS! From the NAVAL OBSERVATORY

U.S. NAVAL OBSERVATORY 3450 MASSACHUSETTS AVE., NW WASHINGTON, DC 20392-5420

U.S. Naval Observatory
Press Release

Geoff Chester
USNO Public Affairs Office
(202) 762-1438
grc@usno.navy.mil

Information Contact:
Dr. Brian Mason
USNO Astrometry Department
(202) 762-1412
bdm@usno.navy.mil

For release at 9:20 am, EST January 6, 2004

Sun-Like Binary Stars Lose Their Companions

We often think of our Sun as a typical middle-aged “garden variety” star, quietly shepherding its planetary companions through billions of years of stable evolution. Such benign conditions have allowed life on Earth to evolve to its present diversity of forms. However, a new study of Sun-like binary star systems may indicate that some of these “typical” stars are not as benign as we once thought.

Dr. Brian D. Mason, an astronomer at the U.S. Naval Observatory (USNO) in Washington, DC, and his collaborators have gathered compelling evidence that these star systems tend to break apart over time. These results are being presented today to the 203rd Meeting of the American Astronomical Society in Atlanta, GA.

Dr. Mason worked with collaborators William I. Hartkopf (USNO), Todd J. Henry (Georgia State University, Atlanta, GA), and David Soderblom (Space Telescope Science Institute, Baltimore, MD) to observe more than 2,300 stars that are similar to our Sun, but spanning a range of ages of about 10 billion years. The ages of these stars were determined by Dr. Soderblom, who used indicators of magnetic activity in the stars’ chromospheres, similar to the mechanisms responsible for spots, flares, and powerful magnetic disturbances on our Sun.

Roughly two out of three stars in the night sky are not solitary travelers through space; they have companions, forming systems with two or more stars orbiting a common center of mass. In this context the Sun is an anomaly, since it is accompanied by a rag-tag assemblage of small bodies (planets, asteroids, and comets) whose total mass is far less than that of even the feeblest star.

Young solar-type stars show much higher levels of activity in their chromospheres than our Sun currently does, and there is a steady decline in such activity as these stars age. The observations to measure this activity were made at Kitt Peak National Observatory near Tucson, Arizona and the Cerro Tololo Interamerican Observatory in Chile. Both are operated by the National Optical Astronomy Observatories for the National Science Foundation.

The key observations in this study were led by Dr. Mason and were done to determine how many and what kind of companions the observed stars have. The technique used is called "speckle interferometry", and involves taking a very rapid series of images of bright stars to record individual pinpoints of light produced by distortion in the Earth's atmosphere that move too fast for the human eye to see. These pinpoints are correlated by a computer into a single image, allowing full use of a telescope's capabilities. A typical image from a ground-based telescope would appear as a blur of starlight, but the correlated images produced by the speckle camera can reveal the presence of close companion stars within the circle produced by the blurring distortion. The speckle interferometry camera is optimized for detecting binaries at the resolution limit of the telescope, so it is well suited for examining these stars.

The results from this study are being used to examine the details of the kinds of companions that Sun-like stars have, but the most important finding is shown by taking the full sample and placing these stars into four age bins based on their chromospheric activity. As shown in the graph (Figure 1), there is a clear and continuous drop in the frequency with which stars have companions. In the youngest bin, 18% of stars have companions; this falls to 10% for the next bin (age about 1 billion years), then to 7% at about 4 billion years, and to 3% for the oldest stars (6 billion years and older).

This decline is unambiguous, but the reason for it is less clear. The oldest stars could have formed with fewer companions in the first place, but there is no basis for believing that. However, astronomers are aware that there are factors that disrupt clusters of stars in our Galaxy, leading to them being torn apart with time. The observations reported here suggest that the same or similar factors cause binary companion stars to be lost over time. Serendipitous to these investigations was the discovery of eleven new binary systems, one of which is shown in Figure 2.

The detection of doubles by speckle interferometry is limited to companions of similar brightness and will not detect doubles which are quite close. However, these limitations apply to all data bins. The error bars on multiplicity are rather large for the very active and very inactive samples due to the small number of stars in those respective bins, though the other two bins are quite well populated.

This work has been supported by NASA and the SIM preparatory science program through NRA 98-OSS-007. We gratefully acknowledge this support.

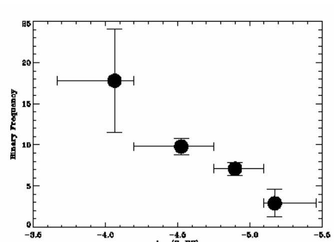

Figure 1: Chromospheric activity vs. multiplicity frequency.

EDITORS: This plot of the four age bins and their multiplicity frequency can be obtained over the Internet via http://www.usno.navy.mil/pao/Digipix/chromosplot.jpg as soon as the embargo expires.

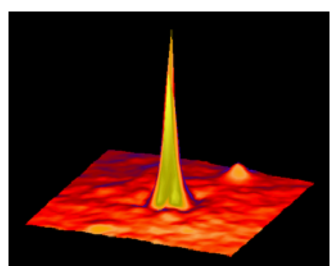

Figure 2: The newly discovered binary, WSI 28 (HIP 40001). Separation (ρ) = 0.270 arcseconds.

EDITORS: This false-color detection of the binary can be obtained over the Internet via http://www.usno.navy.mil/pao/Digipix/WSI28.jpg as soon as the embargo expires.